ENERGY CENTER
OF WISCONSIN

March 16, 2005

TO: Wisconsin Potential Study Advisory Committee and stakeholders

FROM: Ingo Bensch, ECW

RE: Advance materials for March 18 stakeholder meeting

Below are advance materials for the March 18, 2005 Potential Study Stakeholder meeting covering the following five markets:

1. (9:00-10:15 am) Market 18 — **Rental building common-area lighting purchase**
2. (10:30-11:45 pm) Market 21 — **Rental heating system replacement**
3. (12:00-1:15 pm) Market 30 — **Rental fuel switching**
4. (1:30-2:45 pm) Market 27 — **Hot water savers (renter aspects)**
5. (3:00-4:15 pm) Market 17 — **Retail lighting purchase (renter aspects)**

(If you are planning to attend this meeting, and have not already done so, please RSVP to sbenzmiller@ecw.org. Lunch will be provided for those who will be present for the meeting at noon.)

A generic discussion guide follows, along with some facts about the markets to be discussed and some issues I have identified. These are simply meant to get the discussion going; they're not intended to limit the scope of the discussion.

Generic Discussion Guide

1. Size and nature of the market
    a. What are the important market channels and actors for this market?
    b. What are the important motivators and barriers to energy efficiency in this market?

2. Measure impacts
    a. What are the important measures or energy efficiency upgrades to contemplate for this market?
    b. What are the most important variables that drive per-unit impacts and measure life for these measures?
    c. Do measure impacts and measure life vary among sub-groups or across participants in future years in important ways that we should consider?

3. Program approaches
    a. What program approaches to improving energy efficiency in this market have been used in Wisconsin and elsewhere?
        i. Are there specific programs (Wisconsin or elsewhere) that we should be using as models for estimating achievable potential for Wisconsin?
    b. What novel program approaches should we consider?
    c. What participation levels and program costs are likely for these program approaches?
    d. To what extent is free ridership an issue to be considered for these program approaches?
    e. To what extent can these program approaches be expected to engender broader market effects beyond immediate participants?

4. Information resources (identify throughout the above)
    a. What information sources can we draw upon to address this question?

Rental Markets – some relevant facts

(See also market-specific data for additional relevant facts.)

- Greater barriers than in non-rental markets. (Best Practices report, 2001)

- Multi-family programs tend not to address market transformation in a comprehensive way. (Best Practices report, 2001)

- Energy impacts of existing Focus on Energy have come primarily from:

Energy Savings	***Demand Savings***	***Natural Gas Savings***
Reward subprogram	Whole Building – Existing DI subprogram	Whole Building – Existing subprogram
Whole Building – Existing subprogram	Whole Building – Existing subprogram	Whole Building – Existing DI subprogram

(source: Focus evaluation team tracking research, 2001-2004)

- Wisconsin rental housing comprises 658,000 housing units in 278,000 buildings. The state's rental housing falls into two distinct groups: small single- and multi-family buildings (up to 4 units) and larger multi-family buildings (>5 units). Table 1 shows some key metrics, energy characteristics, and barriers for each of these groups. (source: draft Energy and Rental Housing – a Wisconsin Characterization Study)

Table 1: Key Statistics about Small and Large Rental Buildings

Characteristic	***Small Rental (1-4 units)***	***Large Rental (5+ units)***
number of units	>50%	<50%
number of buildings	>90%	<10%
electricity consumption	70%	30%
natural gas consumption	70%	30%
share of technical energy-eff. opportunities	70%	30%
nature of opportunities with paybacks ≤5 yrs	• in-unit lighting • water heating	• common area lighting* • in-unit lighting • water heating
nature of opportunities with paybacks >5 yrs	building shell improvements	heating system upgrades
electricity cost paid by landlord	~0%	>40%
natural gas cost paid by landlord	~0%	>95%
decision-maker(s)	investor	various

* buildings with 5 to 20 units

(source: draft Energy and Rental Housing – a Wisconsin Characterization Study)

TABLE 2 HEATING SYSTEM OPPORTUNITIES

	PERCENT OF BUILDINGS WITH OPPORTUNITY							AVERAGE SAVINGS AND COST PER AFFECTED DWELLING UNIT[B]	
	UNITS IN BUILDING				LOW-INCOME BUILDING?		PERCENT OF UNITS[A]		
	1	2-4	5-19	20+	YES	NO		SAVINGS	COST
2-year payback									
Furnace replacement	0	0	0	0	0	0	0	—	—
Furnace upgrade on failure	3	5	0	0	3	4	2	$287	$500
Fuel switch electric heat	0	0	0	0	0	0	0	—	—
Boiler replacement	0	0	0	0	0	0	0	—	—
Boiler upgrade on failure	0	0	3	1	0	<1	1	$220	$411
Boiler controls	0	0	19	5	<1	2	5	$41	$40
Boiler pipe insulation	0	2	13	13	<1	3	8	$5	$6
5-year payback									
Furnace replacement	0	0	0	0	0	0	0	—	—
Furnace upgrade on failure	30	14	2	0	27	21	11	$164	$489
Fuel switch electric heat	0	5	0	0	3	0	1	$1,154	$4,000
Boiler replacement	0	0	1	2	0	<1	1	$54	$234
Boiler upgrade on failure	0	0	4	8	<1	<1	3	$113	$269
Boiler controls	0	2	20	8	2	2	6	$39	$49
Boiler pipe insulation	0	2	13	13	<1	3	8	$5	$6

(source: draft Energy and Rental Housing – a Wisconsin Characterization Study)

TABLE 3 WATER HEATING OPPORTUNITIES

	PERCENT OF BUILDINGS WITH OPPORTUNITY						PERCENT OF UNITS[A]	AVERAGE SAVINGS AND COST PER AFFECTED DWELLING UNIT[B]	
	UNITS IN BUILDING				LOW-INCOME BUILDING?				
	1	2-4	5-19	20+	YES	NO		SAVINGS	COST
2-year payback									
Fuel switch electric	0	0	1	5	<1	0	1	$136	$164
Temperature reduction	28	49	60	38	37	43	33	$13	$0
Replacement (small)	0	0	0	0	0	0	0	—	—
Replacement (large)	0	0	0	0	0	0	0	—	—
Wrap	47	40	36	51	53	39	43	$11	$15
Showerheads	61	81	70	93	83	59	74	$28	$10
Pipe insulation	44	32	41	27	54	27	35	$7	$6
5-year payback									
Fuel switch electric	35	1	1	12	18	26	11	$227	$562
Temperature reduction	28	49	60	38	37	43	33	$13	$0
Replacement (small)	0	0	0	0	0	0	0	—	—
Replacement (large)	0	0	0	8	0	0	2	$36	$118
Wrap	76	82	75	84	79	83	77	$9	$18
Showerheads	61	81	70	93	83	59	74	$28	$10
Pipe insulation	44	32	41	27	54	27	35	$7	$6

(source: draft Energy and Rental Housing – a Wisconsin Characterization Study)

TABLE 4 LIGHTING OPPORTUNITIES

	PERCENT OF BUILDINGS WITH OPPORTUNITY								
	UNITS IN BUILDING				LOW-INCOME BUILDING?		PERCENT OF DWELLING UNITS[A]	AVERAGE SAVINGS AND COST PER AFFECTED DWELLING UNIT[B]	
	1	2-4	5-19	20+	YES	NO		SAVINGS	COST
2-year payback									
LED exit lights	0	0	3	10	<1	1	3	$4	$7
Common-area lighting replacement	0	2	12	25	<1	3	8	$29	$38
In-unit lighting replacement	100	99	100	100	100	99	100	$42	$36
Outdoor/entry lighting controls	33	24	15	7	26	28	20	$192	$61
5-year payback									
LED exit lights	0	2	15	26	1	3	10	$6	$13
Common-area lighting replacement	0	28	77	69	10	19	39	$28	$85
In-unit lighting replacement	100	99	100	100	100	99	100	$49	$57
Outdoor/entry lighting controls	36	33	30	17	33	34	30	$130	$48

(source: draft Energy and Rental Housing – a Wisconsin Characterization Study)

Rental Building Common-Area Lighting Purchase

Market description

This market involves multifamily building operators who purchase lighting products for common-areas in existing buildings. Includes renovation projects. Does not include lighting purchased for new buildings.

Some relevant facts

(See also "Rental Markets – some relevant facts" near beginning of this memo.)

TABLE 5, COMMON AREA LIGHTING CHARACTERISTICS (EXCLUDING EXIT LIGHTS)

	UNITS IN BUILDING				LOW-INCOME BUILDING?		ALL BLDGS
	1	2-4	5-19	20+	YES	NO	
Buildings with common area lighting	0	55	97	100	6	72	78
Average number of fixtures per building	0	7	19	70	22	12	13
Fixture type (%)							
Wall		25	31	37	38	30	30
Ceiling		71	61	59	59	66	65
Other		4	8	4	3	4	4
Bulb type (%)							
Incandescent	—	82	51	5	54	49	50
Fluorescent fixture	—	5	18	27	24	20	20
Screw-based CFL	—	6	13	26	2	9	9
Pin-based CFL	—	5	12	37	16	16	16
Other	—	2	6	5	4	6	5
Average bulb wattage							
Incandescent	—	70	60	60	61	65	64
fluorescent fixture	—	33	29	36	36	32	33
Screw-based CFL	—	17	16	23	20	16	16
Pin-based CFL	—	13	15	13	13	14	13

(source: draft Energy and Rental Housing – a Wisconsin Characterization Study)

TABLE 6. EXIT LIGHT CHARACTERISTICS

	UNITS IN BUILDING				LOW-INCOME BUILDING?		ALL BLDGS
	1	2-4	5-19	20+	YES	NO	
Average number of exit lights per building		2	3	16	4	7	7
Bulb type (%)							
Incandescent	-	47	33	10	40	20	23
Fluorescent	-	18	34	37	43	36	37
LED	-	23	29	46	10	39	35
Other	-	12	4	7	7	5	5

(source: draft Energy and Rental Housing – a Wisconsin Characterization Study)

Issues for discussion

- What would an effective program approach be – with and without budget constraints?
- Is there a point at which a program for common area retail lighting can shift from one-on-one interventions to something prescriptive that runs more on auto-pilot?
- What factors (other than budget) limit the share of inefficient common area lighting that a program could shift to efficient options?
- What trends are likely in the absence of a program?
- What other information sources would be helpful for this market?

Rental Heating System Replacement

Market description

This market is defined as multifamily operators who are seeking to replace existing boilers as well as those engaging in renovation projects. Potential estimates will be based on the program options to encourage high efficiency replacements, modular installations, and controls to maximize system performance. Does not include systems purchased for new buildings.

Some relevant facts

(See also "Rental Markets – some relevant facts" near beginning of this memo.)

- There are about 350,000 forced air furnaces in Wisconsin rental buildings. Most of these are inefficient (only 14% are high efficiency condensing models) and reside in in single-family rental homes and small multifamily buildings, where tenants tend to pay energy costs. (source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

- There are about 27,500 hydronic boiler heating systems in Wisconsin rental buildings. Although more prevalent in large apartment buildings, these systems are also found in smaller buildings and single-family rental units. The average Wisconsin boiler is 21 years old. (source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

- The Rental Characterization Study found little potential for heating system replacement with less than a five year payback. However, efficiency upgrades on failure can provide opportunities in the 5 to 10 year payback range for some boiler replacements in buildings with 5 or more units and furnaces in 1-4 unit buildings. (source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

TABLE 7. SPACE HEATING CHARACTERISTICS

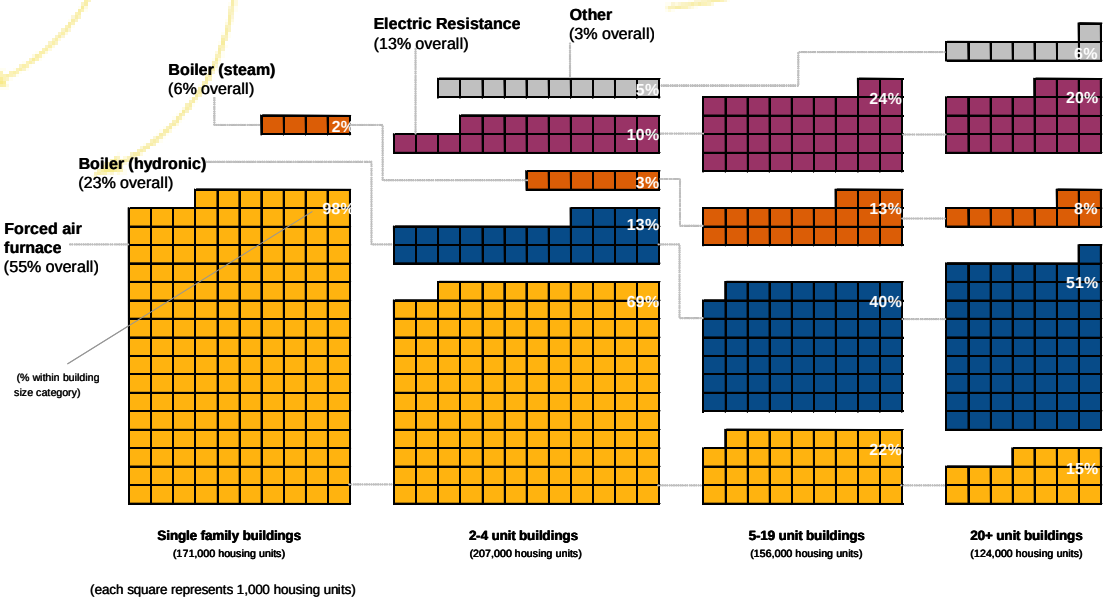
	UNITS IN BUILDING				LOW-INCOME BUILDING?		HEAT PAID BY TENANT?[A]		ALL BLDGS
	1	2-4	5-19	20+	YES	NO	YES	NO	
Who pays the heat?									
Tenants	100%	84%	44%	49%	98%	85%			91%
Landlord	0%	15%	56%	51%	2%	14%			9%
Mix in same bldg	0%	1%	0%	0%	0%	<1%			<1%

Heating fuel									
Natural gas	85%	84%	72%	59%	93%	79%	83%	92%	83%
Electricity	0%	6%	27%	38%	4%	5%	4%	1%	4%
Propane	9%	0%	0%	0%	0%	10%	6%	0%	6%
Fuel oil	6%	2%	1%	0%	0%	4%	4%	7%	4%
Dual fuel	0%	0%	0%	1%	<1%	0%	0%	<1%	<1%
District	0%	0%	0%	1%	0%	0%	0%	<1%	<1%
Mix in same bldg	0%	9%	0%	1%	3%	3%	3%	<1%	3%
Central system or individual system for each unit?									
Central	0%	19%	57%	44%	4%	15%	2%	85%	10%
Individual	100%	81%	41%	55%	96%	85%	98%	14%	90%
Mix in same bldg	0%	0%	2%	1%	0%	<1%	0%	1%	<1%
Type of heating system									
Forced air furnace	98%	71%	20%	18%	89%	77%	89%	27%	83%
Hydronic boiler	0%	10%	41%	40%	2%	9%	1%	54%	6%
Steam boiler	2%	3%	12%	4%	1%	5%	2%	18%	3%
Electric resistance	0%	5%	27%	31%	4%	4%	4%	1%	4%
Heat pump	0%	0%	0%	6%	0%	<1%	<1%	0%	<1%
Space heater	0%	4%	0%	0%	<1%	2%	1%	0%	1%
Radiant	0%	<1%	0%	0%	0%	<1%	<1%	0%	<1%
Mix in same bldg	0%	7%	0%	2%	3%	2%	3%	<1%	2%

[A]Excludes buildings where the landlord pays the heating bills for some units and tenants pay for others

(source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

FIGURE 1, RENTAL HOUSING UNITS BY HEATING SYSTEM TYPE AND BUILDING SIZE



Issues for discussion

- Where is the achievable potential for larger (5+) buildings: high efficiency replacements, modular installations, or controls to maximize system performance?
- What would an effective program approach for larger buildings be – with and without budget constraints?
- Is there a point at which a program for larger buildings can shift from one-on-one interventions to something prescriptive that runs more on auto-pilot?
- What would an effective program approach for smaller buildings be – with and without budget constraints?
- Is there any substantial potential for early replacements?
- What factors (other than budget) limit the share of heating systems that a program could influence?
- What trends are likely in the absence of a program?
- What other information sources would be helpful for this market?

Rental Fuel Switching

Market description

This market embraces programs to encourage the conversion of rental housing with electric space heating or water heating to gas-fired systems. This includes opportunities associated with renovation.

Some relevant facts

(See also "Rental Markets – some relevant facts" near beginning of this memo.)

About 10,000 rental buildings (encompassing 11 percent of all rental units) employ electric resistance space heating. About half of these are small multifamily buildings (2-4 units), and the other half are apartments in larger buildings. The average building with electric baseboard heat is 24 years old. (source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

A significant minority of buildings of all sizes have electric water heaters. In all but the largest buildings, these are conventional storage-tank water heaters. About a quarter of large buildings (20+ units) use space heating boilers to indirectly provide domestic hot water. (source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

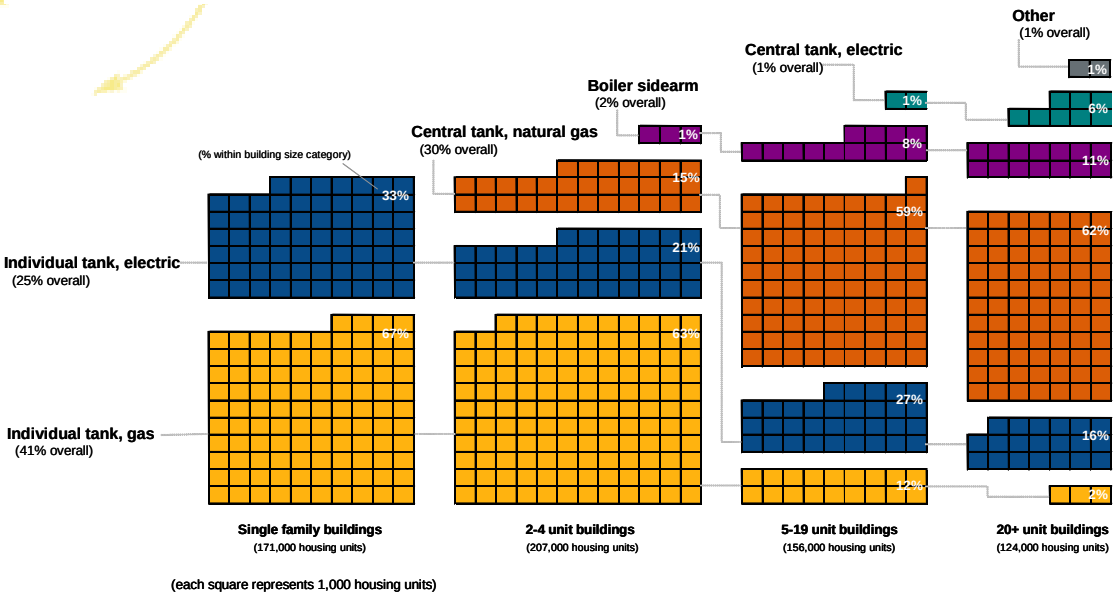
About one in six buildings with natural gas space heating have electric water heating. These are most likely to be single-family rental homes or 2-4 unit rental buildings. (source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

TABLE 8. WATER HEATING CHARACTERISTICS

	UNITS IN BUILDING				LOW-INCOME BUILDING?		
	1	2-4	5-19	20+	YES	NO	ALL BLDGS
Who pays for heating?							
tenant	97	87	41	31	97	87	89
landlord	3	12	59	69	3	12	10
mix in same building	0	1	0	0	0	1	<1
Central vs individual (%)							
central system	0	13	59	69	5	12	8
individual	100	85	41	31	95	87	91
mix	0	2	0	0	0	1	1
Type (%)							
conventional	100	99	99	71	77	81	81
sidearm	0	1	0	27	22	17	17
other	0	0	1	2	2	2	2
Fuel (%)							
natural gas	67	79	68	59	65	72	71
electric	33	16	31	40	31	27	28
other	0	0	1	1	<1	<1	<1
mix	0	5	0	0	3	1	2
Average size							
Individual							
Tank size, gallons	55	46	51	55	53	50	51
capacity, Btuh	27,300	30,400	35,800	28,800	36,000	30,000	31,200
Central							
Tank size, gallons	0	50	50	56	55	55	55
capacity, Btuh	0	31,100	37,900	30,900	35,000	31,200	32,100

(source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

FIGURE 2, RENTAL HOUSING UNITS BY WATER HEATER TYPE AND BUILDING SIZE



Issues for discussion

- What would an effective program approach be – with and without budget constraints?
- Is there a point at which a program for fuel switching can shift from one-on-one interventions to something prescriptive that runs more on auto-pilot?
- What factors (other than budget and availability of other fuel sources) limit the share of electric space and water heaters that a program could shift to efficient options?
- What trends are likely in the absence of a program?
- What other information sources would be helpful for this market?

Hot Water Savers Market (renter aspects)

Market description

This market included showerheads, faucet aerators, water heater insulation blankets, and pipe insulation in apartments and homes.

Some relevant facts

The Rental Characterization Study found measured temperature of hot water in rental units averaged 126 degrees overall, and was relatively consistent across building sizes. Measured showerhead flow rates indicated somewhat higher flows in larger buildings compared to smaller ones. (source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

The Rental Characterization Study collected information on the presence of tank wrap insulation and the percentage of pipe wrap insulation. Additional tank wrap insulation is found in about a quarter of small multifamily buildings (2-4 units), but is less common (or rare) among other building sizes. Hot water pipe insulation is more likely to be found among large (20+ unit) buildings than in other building size categories. (source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

TABLE 9. WATER HEATING CHARACTERISTICS

	UNITS IN BUILDING				LOW-INCOME BUILDING?		
	1	2-4	5-19	20+	YES	NO	ALL BLDGS
Insulation							
% with tank wrap	11	26	11	1	7	6	6
fraction of basement piping insulated (%)							
none	67	60	66	70	43	74	68
less than half	11	21	12	0	11	3	4
more than half	0	5	5	4	0	4	3
all	17	15	17	26	46	18	23
Other							
Avg. delivered water temp.(°F)	129	126	126	126	121	127	126
(% >135F)	25	13	37	17	17	29	22
Showerhead flow rate (gpm)	2.3	2.5	2.5	2.7	2.5	2.6	2.7
(% >2.5 gpm)[a]	49	80	68	93	65	59	60

[a]Percent of buildings with at least one showerhead measured above 2.5 gpm.

(source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

Issues for discussion

- What would an effective program approach be – with and without budget constraints?
  - ➢ Is there anything beyond direct install we should consider for the renter aspect of this market?
  - ➢ Is this program distinct from a direct install program for in-unit lighting or is it the same?
- What factors (other than budget) limit the share of "excessive" hot water using devices or temperature settings that a program could shift to efficient options?
- What trends are likely in the absence of a program?
- What other information sources would be helpful for this market?

Homeowner/Rental Retail Lighting Purchase (Renter Aspects)

Market description

This market involves homeowners or renters purchasing light bulbs for existing luminaires in homes and apartments, but may also incorporate efficient luminaire alternatives, such as torchieres. Potential estimates will be based on programmatic approaches to increasing the market share of CFLs. Does not include lighting fixtures for new homes, or those purchased for remodeling projects.

Some relevant facts

TABLE 10. IN-UNIT LIGHTING CHARACTERISTICS

	UNITS IN BUILDING				LOW-INCOME BUILDING?		ALL BLDGS
	1	2-4	5-19	20+	YES	NO	
Average number of fixtures							
Per unit	15	11	12	9	10	11	11
Fixture Type (%)							
Ceiling	67	64	55	48	58	60	60
Table lamp	9	15	14	21	13	14	14
Floor lamp	5	5	8	7	3	6	6
Wall	17	13	22	22	18	18	18
Other	3	3	1	2	8	2	2
Bulb type (%)							
incandescent	81	88	95	89	91	87	88
fluorescent fixture	14	4	3	5	6	7	7
Screw-based CFL	2	3	0.3	2	2	2	2
Pin-based CFL	2	4	0.5	2	2	3	2
other	1	1	1	2	0	1	1
Average bulb wattage							
incandescent	66	62	60	63	64	62	63
fluorescent fixture	38	40	32	30	34	37	37
Screw-based CFL	20	17	32	27	26	20	20
Pin-based CFL	16	30	21	17	16	29	28

(source: draft Energy and Rental Housing – A Wisconsin Characterization Study)

Issues for discussion

- What would an effective program approach be – with and without budget constraints?
    - Is there anything beyond direct install we should consider for the renter aspect of this market?
    - Is this program distinct from a direct install program for hot water savers or is it the same?
- What factors (other than budget) limit the share of inefficient in-unit lighting that a program could shift to efficient options?
- What trends are likely in the absence of a program?
- What other information sources would be helpful for this market?